Mobile Decision Support System Usage in Organizations

Research-in-Progress

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ABSTRACT

In recent years, people have widely adopted mobile computing devices in their lives. In this paper, we define mobile decision support systems (mDSS) as decision support systems built on mobile computing platforms. Several factors influencing an individual employee's usage of mDSS are examined. We propose a model shows how perceived usefulness, perceived ease of use, job mobility, and amount of information presented influence employees' mDSS usage. In addition, employees' mobile real-time-decision-making (mRTDM) responsibility will moderate the positive effects that job mobility has on their mDSS usage. This exploratory study seeks to define mDSS and understand how people will use these systems in organizations with today's rapidly growing mobile technology.

Keywords

Mobile Decision Support Systems (mDSS), Cognitive capability, System Usage, Job requirements, Decision Making.

INTRODUCTION

One of the most significant trends in information systems today is the proliferation of mobile computing devices such as smart phones and tablet computers. The market for these mobile devices has expanded dramatically since 2007. According to Apple, Inc., their iPhone sales in 2007 were only 1.39 million units worldwide; in 2012, that number has increased to 125.05 million units. Total worldwide smart phone sales in 2012 reached 712.6 million units (IDC, 2013), and people are using these mobile devices regularly in their daily lives. Gartner market research firm predicted that mobile app stores served 17.7 billion downloads in 2011, up 116% from an estimated 8.2 billion in 2010, and that application downloads will soar to 185 billion by 2014 (Anthes, 2011).

The growth in mobile computing devices has created both opportunities and challenges for business to expand their computing environment. Mobile computing devices have become more and more powerful in performance, yet their compact size provides them great mobility. These characteristics make mobile devices very competitive in providing real-time decision support capability and flexibility to not only managers but also employees in various organizations. Therefore, mobile computing devices serve as ideal platforms to build new types of decision support systems. Many organizations are aware of this new trend in mobile computing devices usage. Most of them are starting to draft their mobile-device-at-work policies, (e.g. Messmer, 2012 and Hayes, 2012). However, there is a lack of understanding about what factors will affect people's usage of mDSS. In this paper, we first define mDSS, and then provide some empirical support for proposed relationships between different factors and people's mDSS usage.

This paper proceeds as follows: In the next session, we examine the development of DSS, define mDSS, and discuss related literature. Then we present our research model with hypotheses, data collection methods, analysis to support our hypotheses and limitations. Finally, we conclude the paper with some future directions.

MOBILE DECISION SUPPORT SYSTEMS (mDSS)

Decision Support Systems (DSS) are computer systems that can be used to support complex decision making and problem solving processes (Shim et al. 2002). Gory and Scott Morton (1971) developed a framework describing decision support tasks. They defined decisions as structured, semi structured, and unstructured. DSS was then primarily used to help with the structured part of decision making while the unstructured part was largely left to the decision maker. They also argued that as human understanding of the decision making process improves, we will see more and more structured decision-making. In other words, as we learn from our experiences, we accumulate knowledge. Therefore, DSS can aid us more because we are transferring unstructured decisions into structured ones. The traditional DSS is designed for providing decision support to higher-level managers in organizations. A typical DSS or group support system (GDSS) can cost thousands of dollars to develop and implement. Therefore, managers primarily use these systems on "important decisions" such as strategic planning and financial analysis.

In this paper, we define mobile decision support system (mDSS) as decision support systems built on mobile computing devices, which provide people with real time decision-making support capabilities. This definition focuses on the platform more than the type of DSS, because we do not want to limit ourselves to any specific DSS such as dashboards, recommendation systems, or expert systems. By adopting Sprague's (1980) three levels of DSS: DSS generator, DSS tool, and specific DSS, mDSS can be viewed as a new type of DSS generator. We are not aware of anyone has defined mDSS that way. In fact, few has studied the mobile decision support system as a new concept since most people think mobile DSS is just another extension of traditional DSS. We think it is important to realize the difference between a DSS built on a mobile computing device and a DSS implemented on a computer with internet connections.

First, computers are generally more powerful and capable of performing large, complex analysis while mobile computing devices only posses limited power. However, as the computational power of mobile computing devices have reached comparable level to personal computers (PC), the implementation of a DSS on a mobile device is viable. We can build DSSs on mobile computing platforms that are more specialized for decision support related works. This is different from using mobile devices as terminals of larger DSSs. In our definition, the mDSS is mobile computing systems designed to accommodate decision support needs. Second, these mobile computing devices provide us some unique characteristics such as mobility, and wireless connectivity.

One key difference between mDSS and DSS is the mobility associated with mobile computing devices can be used to provide great flexibility in mDSS usage. After review of related literature, we found that some mobile decision support applications are used in health and service oriented industries. For example, there are several DSS implementations such as mobile rescue support system (Shi-Ming, et al. 2002), mobile medical expert system (Cricelli, 2006), business-to-consumer (B2C) m-service systems (Yi-Shun, Hsin-Hui, and Pin, 2006) and mobile banking systems (Burstein et al. 2008). These studies have identified several advantages of using mobile DSS applications including the real time availability of information, the mobility, and increased access to critical knowledge bases. However, they focused on specific types of decision support tasks that can be facilitated by DSS applications. In other words, they are looking at DSS tools and specific DSS. In this paper, we focus on the mobile computing platforms mDSS have, which can be used to build different DSS applications. By introducing the definition of mDSS, we hope to raise the awareness of the decision support capabilities provided by mobile computing devices.

In the literature of decision support systems, one big challenge is how we can handle "the overwhelming flow of data, information, and knowledge produced for executives by an increasing number of sources." (Shim et al. 2002 p. 121) By using mDSS, we can also decentralize the decision-making tasks to lower-level managers. For example, if managers within an organization can access all critical information they need at work, not only will they make quicker, better decisions, their decisions are also better aligned with organization goals and strategies. As discussed by Burstein et al., (2008) an mDSS has two presumed benefits to organizations: first, it provides real time information to decision makers; second, it provides great flexibility in user interfaces. Given these benefits and the trend of more mobile devices at-work, the mDSSs will gain more and more popularity in organizations.

In next section, we will look at the theoretical foundations to identify factors that will affect people's usage of mDSS.

THEORETICAL BACKGROUND

The Technology Acceptance Model (TAM) as well as cognitive capability and task-technology fit theory provide insights on factors influencing people's mDSS usage. In this paper, mDSS is essentially a special type of information system. Therefore, mDSS usage can be categorized as one kind of information technology usage. We would expect that the TAM still applies when people are deciding whether to use mDSS.

Technology acceptance model

TAM (Davis, 1989; Davis et al., 1989) was adapted from the theory of reasoned action (TRA) (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1980). Generally, TAM says that user adoption of a new information system (mDSS in this case) will be determined by the users' intentions to use that system, which in turn will be determined by the users' perceptions about the system. TAM defined two major perceptions about the system: perceived usefulness (PU) and perceived ease of use (PEU). These perceptions can be used to predict the usage intentions of system users.

Perceived usefulness is defined as the extent to which a person believes that using a particular technology will enhance his or her job performance, and perceived ease of use is defined as the extent to which a person believes that using a particular technology will be free of effort. By following TAM, here we will expect the first set of constructs will affect the usage of mobile decision support systems is people's perceptions toward mDSS.

Cognitive Capability

Lerch and Harter (2001) argue that one critical issue facing DSS is to reduce information load on decision makers, especially when came to real time decision-making situations. In addition, Lirnayem and DeSanctis (2000) discuss the cognitive capability effects on decision-making. They cited Kottemann and Davis (1991) and Watson et al. (1988): Laboratory experiments show that decision makers avoid sophisticated decision aids, including group decision support systems (GDSS) and Multiple-criteria decision-making, because these tools reveal decisional conflict. They also mentioned that Gregor and Benbasat (1999) proposed that explanations requiring limited cognitive effort will be used more readily and will be more effective with respect to performance, learning, and user perceptions (Lirnayem and DeSanctis, 2000). Although their work was primarily dealing with group decision making, the concept of cognitive load is important here in mDSS. Due to design and physical limitations, mDSS tends to have limited display size and less input/output options. As mentioned by other researchers, on a desktop PC, viewable screen sizes are much larger. Thus, there could be greater difficulty reading text with smaller screen devices (Buchanan, et al., 2001). Therefore, if we present a large amount of information on mDSS, the cognitive load on users will increase quickly and people will feel they need to put more efforts in using mDSS. Thus, increase in cognitive load could lead to negative reactions to mDSS usage. For example, people may have to browse across different screens to get all the information or people may find it is hard to capture specific information from all the information presented. Our second set of constructs is developed in light of people have limited cognitive capabilities. Since mobile computing devices have some unique characteristics that are related to the cognitive load and information density, we term the second factor as mDSS characteristics factor.

Task Technology Fit

The Task-Technology Fit (TTF) theory (Goodhue and Thompson, 1995) states that information technology is more likely to have positive impact on individual performance and to be used if the capabilities of the IT match the tasks that the user must perform. Here in terms of mDSS, we are also seeing a situation where the mDSS capabilities match the tasks of individuals. For example, if a person holds either a job that requires traveling intensively and he/she also needs to make decisions with decision aids provided by a DSS or in other forms, that person's job could be described as having a high mobility. As mentioned earlier, mobility is one of the most important and significant capabilities of mDSS. Therefore, that person's job requirement matches with mDSS capability, and we expect to see that the person will use mDSS more. Based on that, we propose our third factor as job characteristics that will affect people's usage of mDSS. One of job characteristics is the level of job mobility, which is defined as the frequency a person's job require he/she to travel. As will be discussed later, job mobility will be positively related to people's mDSS usage.

RESEARCH MODEL AND HYPOTHESES

Based on the discussion above, our conceptual model is shown in figure 1 below.

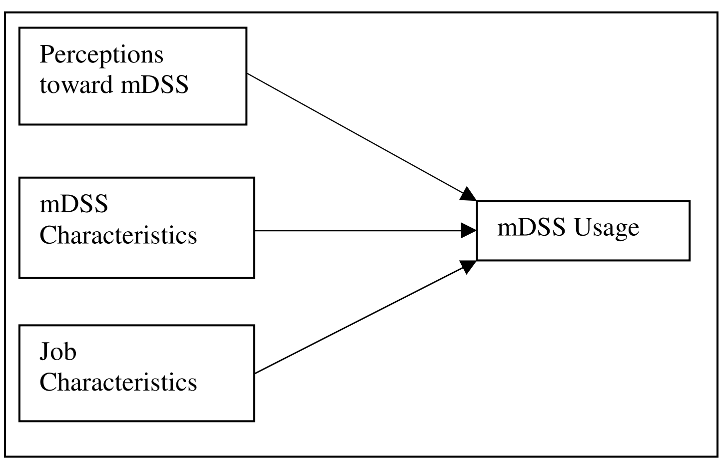

Figure 1: Conceptual Model

The dependent variable in this paper is employee mDSS usage. After looking into related theories, we propose three sets of factors influencing people's mDSS usage: people's perceptions about mobile computing devices, mDSS characteristics, and job characteristics. Based on the discussion above, we derive the following hypotheses:

Hypothesis 1: PU will positively influence mDSS usage.

Hypothesis 2: PEU will positively influence mDSS usage.

Our first two hypotheses are derived from TAM (Davis, 1989; Davis, et al. 1989). TAM predicts that if people think mDSS is useful in improving their work, they are more likely to use it. On the other hand, if people think mDSS is easy to use, they are also more willing to use it. We operationalize the PU and PEU constructs as perceived usefulness and perceived ease of use of mDSS. As defined in this paper, an mDSS is one type of information system. Therefore, the related system design can affect people's perceptions. At the same time, people's perception of mobile computing devices can also potentially bias their perception about the mDSS. We will control these effects in our experiment. For example, if a person thinks a particular mobile device is inferior to others, his/her perception toward the mDSS built on that device will be negatively affected. Thus by measuring people's perception about mobile computing devices we can isolate the mobile device effects and get more clear indications about the relationships among PU, PEU and mDSS usage.

Hypothesis 3: Amount of information presented will negatively influence mDSS usage.

According to the cognitive capability theory discussions, (Lerch and Harter (2001), Lirnayem and DeSanctis (2000), and Gregor and Benbasat (1999)) people generally have limited ability to process information. Therefore, when presented with larger amount of information, they will have to process a larger cognitive load and that eventually will decrease their decision-making efficiency. For example, if we present all information related for a financial decision to a financial manager, it is more likely that the person viewing this information will get overwhelmed and just picks an action which he/she thinks is good enough without fully explore the optimal actions. Instead, if we can narrow the list down to several key indicators of financial performances, people will be able to make decisions that are more effective. In addition, the physical display limitation of mobile computing devices as one key characteristic of these devices is very important in the context of mDSS. In order to maintain mobility, the physical display size on mobile computing devices is limited. We cannot imagine a mobile computing device with more than 11-inch screen display. Within that small display size, if we want presenting more information, we have to either increase information density or spread the information across multiple pages. These could potentially post a larger burden on the users and lead to less mDSS usage since the users have to either process more information within one page or navigate through several pages. Based on the theory and discussion, we propose that there is an inverse relationship between the amount of information presented and mDSS usage.

Hypothesis 4a: The level of job mobility will positively influence mDSS usage.

According to TTF (Goodhue and Thompson, 1995), if a person's job requires him/her to travel more often, he/she will be more likely to use mDSS because the job characteristics match with mDSS capabilities. In addition, the users will more likely appreciate the mobility of mDSS if he/she needs to move more frequently. In that sense, an mDSS will generally be preferred to traditional DSS not only because it can provide the decision support where it is very hard if not impossible for traditional DSS to do, but also because it eliminates the gaps between design and usage of traditional DSS. Therefore, a positive relationship between job mobility and mDSS usage is expected. People who have jobs that are more mobile will be more likely to use mDSSs.

Hypothesis 4b: The level of mRTDM responsibility will moderate the positive relationship between level of job mobility and mDSS usage.

While examining the relationship between job mobility and mDSS usage, another important factor arises. Here we define the mobile real-time-decision-making (mRTDM) responsibility as the degree to which a person is responsible for mobile real-time-decision-making according to his/her job description. For example, a person can hold more mRTDM responsibility, which requires him/her making real-time decisions even when he/she is away from office. In our model, mRTDM responsibility is one important moderator. It will moderate the positive relationship between job mobility and mDSS usage. If the person on a more mobile job does not need to make real-time decisions as often, his/her mDSS usage will be less affected by job mobility. Therefore, the more mRTDM responsibility people have, the more people's job mobility will influence their usage of mDSS. Our model with hypotheses is summarized below in Figure 2:

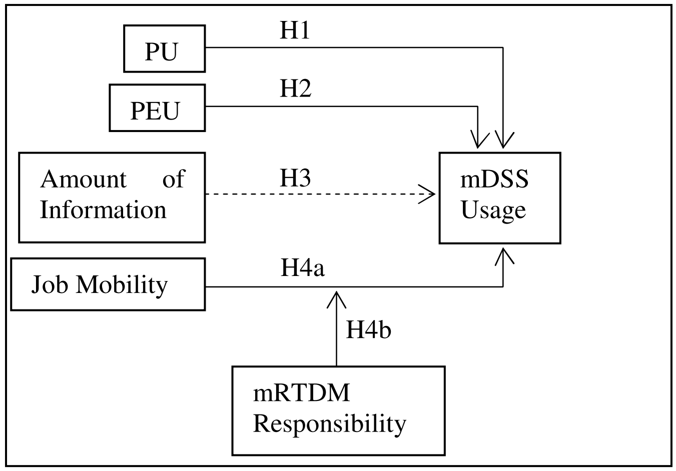

Figure 2: Hypotheses (Dash line represents inverse relationship)

DATA COLLECTION AND ANALYSIS

We choose to use an experiment to gather empirical evidence about the three sets of proposed factors. First, we define the operationalization of each construct in our model.

mDSS usage: This is our dependent variable. We can measure mDSS usage through self-reported usage intentions and actual usage pattern. In our experiment design, mDSS usage will be measured through both self-reported usage intentions and the participants' usage of mDSS applications. Since we are trying to understand the actual mDSS usage patterns, these measurements can give us results that are more relevant.

PE/PU: there are already well-defined measurements for these two constructs. Here in the experiment design we will conduct a follow up survey and adopt items from Davis, (1989) to measure participants' PE/PEU. In experiment design, these variables will be measured before the treatment. Thus, we can control these variables to better separate the main effects.

Amount of information: This is a measurement related to mDSS design characteristics. Because we are not measuring any particular mDSS applications, this could be measured by some general descriptions of mDSS such as the number of screen pages showed on the devices, the number of information entries, and the number of external links in presented information. If the information can be presented within one screen page, given the limit of display, the amount of information will be smaller than if the information goes across several screen pages. Similarly, more entries of information implies larger amount of information presented. Sometimes the information can be linked together by hyperlinks. So the more links we have in the information display, the more information we are presenting to our users. In experiment design, we will manipulate this by providing participants with different vignettes.

Job mobility: This is a job characteristic related variable. We define that as the frequency of travel, visits, and other remote work required on people's job description and actual job duties. In experiment design, this is being manipulated by either assign participants to different descriptions of job duties or grouping participants based on their job characteristics.

mRTDM responsibility: Another job characteristics related variable, this is defined as how much real-time-decision-making responsibility an employee has in his/her job description. In experiment design, this can be manipulated by changing the decision-making contents, vignettes, and descriptions.

Experiment design:

In the experiment, we will have a 3X2 between subject design: the three treatments we manipulate are the amount of information presented, job mobility, and mRTDM responsibility. We plan two stages for the experiment. The first stage we will use students to participant. PE and PEU will be collected through questionnaires administrated before the experiments. We create eight different vignettes based on the description above. The students will be randomly assigned into one of the eight different treatments described below:

Treatments	Amount of information	Job mobility	mRTDM responsibility
1	Small	Low	Low
2	Large	Low	Low
3	Small	High	Low
4	Large	High	Low
5	Small	Low	High
6	Large	Low	High
7	Small	High	High
8	Large	High	High

Table 1: Experiment Treatments

After they read the descriptions that serve as our treatments, each student will answer a series of questions assessing their mDSS usage intentions, demographic information, and manipulation checks. The first stage acts as a pilot study in which we can check the effectiveness of our wordings of treatments, check item reliabilities, and prepare for the second stage.

Since we are interested in the general usage intentions and patterns, in second stage we will set up an experiment environment in which we observe how people are using these mobile DSS applications. In this stage, we are targeting at working adults so our participants will be all individuals with at least some working experiences. The control group will be exposed to no treatment with standard setting of mDSS and their behavior will be recorded as our baseline comparison. In the experiment we will ask these participants to make some job-related decisions such as purchasing raw material, assign financial resources and so on. They will be provided with a simulated mDSS environment. We will collect measurements about their PU and PEU through pretest questionnaires. Treatments we will manipulate will primarily be the amount of information presented, job mobility, and mRTDM responsibility. Each of the participants will be exposed to one of the treatments described in table 1. After the exercise, they will be asked some survey questions to assess their usage intentions toward mDSS.

After we gathered these data, we can run regression analysis on the treatment groups and control groups to see whether these treatments make a significant impact on their mDSS usage. If so, we can gain better understanding and use of powerful mobile devices at work to achieve better performance and decision-making process.

CONCLUSIONS

In this paper, we define a new term to describe the new type of decision support system built on mobile computing devices: mDSS. It can be viewed as a new DSS generator. Given the rapid development and adoption of mobile computing devices, how we can utilize this platform to provide better decision support to employee is an important issue. We propose a model based on three set of theories to explore how different factors influence employees' usage of mDSS. Three sets of factors are studied: people's perceptions about mDSS, mDSS characteristics, and job characteristics. By conducting an experiment, we hope to gain some insights about how these factors affect people's usage of mDSS. The result, if supported, will shed lights on how we can step into this new and expanding area of DSS, it will also provide insights about how people use mDSS in organizations. The practical implications will primarily affect companies that are trying to decide how best they can gather the benefits of mDSS. For example, it will help managers understand why people are using mDSS and how we can get the most out of mDSS.

This paper is an exploratory study. Therefore, there are several limitations. The biggest one is that we are limiting ourselves by only focusing on a small set of factors that could influence mDSS usage. Other factors such as the group decision-making dynamics, organizational communication structure, and manager support can all have some impact on mDSS usage. However, since our interests are the design features and job related conditions, these factors are not our major focus. Besides, future research could be done to further the understanding of mDSS usage. Overall, we hope to gain some insights on factors affecting people's usage of mDSS and on how we can get the most from this massive trend of mobile technology development.

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